

DRAFT

Corrective Action Decision



**Former Unocal Chemical
Distribution Facility Site
2100 E. 37th Street North
Wichita, Kansas**

February 11, 2013

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ACRONYMS AND ABBREVIATIONS USED IN THIS DOCUMENT

ARARs	Applicable or Relevant and Appropriate Requirements	POTW	Publically Owned Treatment Works
AST	Above Ground Storage Tank	QC	Quality Control
CAD	Corrective Action Decision	RAO	Remedial Action Objective
Cis-1,2-DCE	Cis-1,2-dichloroethene	RI	Remedial Investigation
EAB	Enhanced Anaerobic Bioremediation	RSK	Risk-Based Standards for Kansas
EPA	United States Environmental Protection Agency	SVE	Soil Vapor Extraction
ERD	Enhanced Reductive Dechlorination	TCE	Trichloroethene
EUC	Environmental Use Control	URS	URS Corporation
FS	Feasibility Study	VC	Vinyl Chloride
(HRC®)	Hydrogen Release Compound	VOC	Volatile Organic Compound
IM	Interim Measure	µg/L	micrograms per Liter
KDHE	Kansas Department of Health and Environment	µg/kg	micrograms per Kilogram
MCL	Maximum Contaminant Level		
MNA	Monitored Natural Attenuation		
NCP	National Oil and Hazardous Substances Pollution Contingency Plan		
NIC	North Industrial Corridor Site		
OM&M	Operations Maintenance and Monitoring		
PCE	Tetrachloroethene		

GLOSSARY

Administrative Record – The body of documents that form the basis for selection of a particular response at a site. Parts of the AR are available in an information repository near the site to permit interested individuals to review the documents and to allow meaningful participation in the remedy selection process.

Air Stripping – The process of forcing air through polluted water to remove harmful chemicals. The air causes the chemicals to change from a liquid to a gas. The gas is collected and treated if necessary.

Aquifer – An underground layer of rock, sand, or gravel capable of storing water within cracks and pore spaces or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be used for drinking or other purposes. The water contained in the aquifer is called groundwater.

Applicable or Relevant and Appropriate Requirements (ARARs) – The federal and state environmental laws that a remedy will meet. These requirements may vary among sites and alternatives.

Capital Costs – Expenses associated with the initial construction of a project.

Corrective Action Decision – The decision document in which KDHE selects the remedy and explains the basis for selection for a site.

Enhanced Anaerobic Bioremediation (EAB) – the process of allowing anaerobic microbes to clean up contaminants enhanced by adding nutrients.

Exposure - Contact made between a chemical, physical, or biological agent and the outer boundary of an organism. Exposure is quantified as the amount of an agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut).

Feasibility Study (FS) – A study conducted to evaluate alternatives for clean up of contamination.

Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Hydraulic Containment – Use of pump and treat groundwater remediation systems to hydraulically control the movement of contaminated groundwater in order to prevent continued expansion of the contamination zone.

Maximum Contaminant Levels (MCLs)

– The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action. For example, monitoring wells drilled to different depths at the site would be used to detect any migration of the plume.

Monitored Natural Attenuation - Allowing natural processes to remediate pollution in soil and groundwater while site conditions are routinely monitored.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – The federal regulations that guide the Superfund program. These regulations can be found at 40 Code of Federal Regulations, Part 300.

Operations Maintenance and Monitoring (OM&M) – Activities conducted at a site after the construction phase to ensure that the cleanup continues to be effective.

Plume – A body of contaminated groundwater flowing from a specific source.

Remedial Investigation (RI) - A study of the source, nature and extent of contamination.

Risk - The probability of adverse health effects resulting from exposure to an environmental agent or mixture of agents.

Superfund – Federal authority established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), to respond directly to releases or threatened releases of hazardous substances that may endanger health or welfare. Also, the common name given by the press for CERCLA because the program was well funded in the beginning.

Tier 2 Level – Calculated risk-based cleanup value for a specific contaminant. These values can be found in Appendix A of the *Risk-Based Standards for Kansas (RSK) Manual*.

Toxicity – A measure of degree to which a substance is harmful to human and animal life.

Vapor Intrusion – The migration of contaminants from the subsurface into overlying and/or adjacent buildings.

Volatile Organic Compounds (VOCs) – Carbon compounds, such as solvents, which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some VOCs can cause cancer.

1. PURPOSE OF THE DRAFT CORRECTIVE ACTION DECISION

The primary purposes of the draft Corrective Action Decision (CAD) for the Former Unocal Chemical Distribution Facility Site (the Site) are to: 1) summarize information from the key Site documents including the Remedial Investigation¹(RI) and Feasibility Study² (FS) reports; 2) briefly describe the alternatives for remediation detailed in the FS report; 3) identify and describe the Kansas Department of Health and Environment's (KDHE) preferred remedy for contamination at the Site; and, 4) provide an opportunity for public comment on the preferred remedy.

KDHE will select a final remedy for the Site after reviewing and considering all information submitted during the 30-day public comment period. KDHE may modify the preferred alternative based on new information or public comments; therefore, the public is encouraged to review and comment on the preferred remedy presented in this draft CAD. The KDHE will hold a public availability session during the 30-day public comment period to present information regarding the preferred remedy and solicit public participation. The public may submit written comments to KDHE during the public comment period (February 11, 2013 - March 12, 2013). Section 9.0 provides more information on the procedures for providing comments on the draft CAD.

Numerous consultants have performed investigative and remedial tasks on behalf of Chevron Environmental Management Company (Chevron-EMC), formerly known as Union Oil Company of California (Unocal). URS Corporation (URS) prepared the RI and FS for the Site on behalf of Chevron EMC. Work performed during the RI and FS process followed the terms outlined in the March 1992 Consent Agreement between Unocal and KDHE. The public is encouraged to review and comment on the technical information presented in the RI and FS reports and other documents contained in the Administrative Record file. The Administrative Record file includes all

Highlight 1-1: Public Information

Administrative Record File

Kansas Department of Health and Environment
Bureau of Environmental Remediation
1000 SW Jackson Street; Suite 410
Topeka, Kansas 66612-1367
Contact: Holly Burke
Phone: 785-296-6242
E-mail: hburke@kdheks.gov
Web: www.kdheks.gov/remedial/site_restoration/unocal.html

Local Information Repository

City of Wichita Department of Public Works and Utilities
Environmental Health Division
1900 E. Ninth Street
Wichita, Kansas 67214
Contact: Shawn Maloney
Phone: 316-268-8351
E-mail: smaloney@wichita.gov

¹ URS, 2007, *Final Revision 0 Remedial Investigation (RI) Report, Former Unocal Chemical Distribution Facility, Wichita, Kansas*, prepared on behalf of Chevron, approved December 2007.

² URS, 2009, *Final Revision 1 Feasibility Study Report, Former Unocal Chemical Distribution Facility, Wichita, Kansas*, prepared on behalf of Chevron, approved July 2009.

pertinent documents and Site information that form the basis and rationale for selecting the final remedy. The Administrative Record File is available for public review during normal business hours at the KDHE location shown in Highlight 1-1. Also, as shown, for convenience to interested members of the public, copies of the RI and FS reports, as well as the draft CAD, will also be available for review and copying during normal business hours at the local information repository located at the City of Wichita's Environmental Health Division Offices.

2. SITE BACKGROUND

2.1. Site Location

The former Unocal facility is approximately 2.4 acres and is located at 2100 E. 37th Street North in Wichita, Kansas. The Site is located within the larger North Industrial Corridor (NIC) Site, an area of regional groundwater contamination, as shown on Figure 2-1. Figure 2-2 shows the layout of the former facility and the primary source areas. The Unocal property as well as the surrounding properties are zoned for general industrial use.

2.2. Site History

Facility operations began at the Site in 1953. Prior to 1953, the Site was undeveloped agricultural land. The Former Unocal Chemical Distribution Facility was operated as a chemical storage and distribution facility from 1953 until 1992, when operations ceased. During its operations, the facility received bulk shipments of containerized liquid chemicals, stored bulk chemicals in aboveground storage tanks (ASTs), blended bulk chemicals for customers and packaged and transported bulk and containerized liquid chemicals to customers. Chemicals were received by the facility by railcar and truck. Chemicals were stored in 55-gallon drums in a warehouse and drum storage area, in 500-gallon Department of Transportation certified containers, and temporarily in rail cars. The types of chemicals handled at the facility included, but were not limited to, aromatic hydrocarbons, aliphatic hydrocarbons, chlorinated hydrocarbons, and petrochemicals.

Contamination at the Site was identified when an accidental release of tetrachloroethene (PCE) occurred on November 3, 1989. Unocal contractors attempted to excavate the spill area; however, it was later determined that excavation activities would not completely remediate the affected area. In response to the 1989 PCE spill, Unocal contractors installed a soil vapor extraction (SVE) system in the affected area, which became operational on November 22, 1989. Additional Site characterization activities were conducted at the Site in 1990 and 1991 to evaluate the nature and extent of subsurface contamination attributable to the Unocal facility. On the basis of information gained from these investigations, in 1992 KDHE and Unocal entered into a Consent Order for a RI and FS. The Consent Order outlined the requirements for investigating and evaluating remedial alternatives for the Site.

3. REMEDIAL INVESTIGATION

The RI process was conducted in several phases beginning in 1992 and ending in 2007 with KDHE's approval of the final RI Report (URS 2007). Objectives of the RI process include:

- Characterizing all significant source areas to determine appropriate cleanup goals (i.e., type and nature of source(s) of contaminants, cause of release, estimated quantity of release(s), and if the release(s) is/are active or inactive);
- Characterizing the vertical and horizontal extent of contamination (including migration mechanisms) for the purpose of and to the extent necessary for developing and evaluating effective remedial alternatives;
- Characterizing the chemical and physical properties of the contaminants, their mobility and persistence in the environment and their important fate and transport mechanisms;
- Identifying any human and environmental targets that may be affected by contamination; and,
- Developing individual source control plans for those areas identified as “hot spots” or areas of highest contamination.

3.1. Geological and Hydrogeological Setting

The RI included assessment of the geology and hydrogeology for determining pathways of contaminant migration. Approximately half of the Site is covered by gravel. In areas not covered by gravel, surface soil to a depth of approximately 2 feet consists of dark reddish-brown silty clay in the upper soil horizon which grades into orange brown silty-clay alluvial deposits. These alluvial deposits are approximately 10-15 feet thick and include silt, sand, and gravel lenses. The underlying bedrock consists of weathered and unweathered Wellington Shale. A single unconfined aquifer is present at the Site, and data collected in 2011 show the water table varying between 1.52 feet below ground surface (bgs) and 21.15 feet bgs. Figure 3-1 depicts the top of the weathered bedrock and groundwater flow directions in the vicinity of the Site. Groundwater flow direction is generally towards the south to southwest; however, a westerly flow component has been identified west of the facility as shown in Figure 3-2.

3.2. Summary of Remedial Investigation Results

The RI process included the collection of more than 130 direct-push groundwater samples, more than 260 soil samples, a membrane interface probe investigation and the installation and sampling of numerous monitoring wells in the Site vicinity (i.e., on the Unocal property and adjacent properties). It should be noted that some screening soil samples (i.e., those with insufficient Quality Control (QC) and/or disagreement between on-site and off-site datasets), along with those soil samples from locations within excavation areas, were used to help define the extent of impact but are not discussed in detail in the final RI Report.

The RI identified contamination in soil and groundwater originating from several release areas across the Site, each distinguishable by a unique set of chemical constituents. The RI Report refers to these chemically distinct releases and associated plumes as “plumelets.” Table 3-1 summarizes the maximum concentrations and current maximum concentrations for select contaminants of concern in groundwater with comparisons to KDHE’s respective Tier 2 Levels³.

³ KDHE, 2010, *Risk-Based Standards for Kansas (RSK) Manual*, 5th Version, Kansas Department of Health and Environment, October.

Table 3-2 provides the maximum concentrations of select contaminants of concern in soil. It should be noted that many of the soil concentrations listed in Table 3-2 are from samples which were excavated during source abatement activities. A more comprehensive data summary is provided in the final RI Report (URS 2007). Each plumelet identified at the Site is comprised of a unique chemical suite. In some cases, the combination of chlorinated volatile organic compounds (VOCs) with petroleum hydrocarbon-related chemicals has facilitated enhanced reductive dechlorination (ERD) of the chlorinated compounds present at the Site. Figure 3-3 presents the current orientation of the PCE plumelets identified at the Site.

4. SOURCE ABATEMENT, INTERIM MEASURES, AND PILOT TEST IMPLEMENTATION

Interim measures (IMs) are actions or activities taken to quickly prevent, mitigate, or remedy unacceptable risk(s) posed to human health and/or the environment by an actual or potential release of a hazardous substance, pollutant, or contaminant. Numerous IMs, pilot tests (some of which were full scale equivalents), and source area remedial actions have been implemented at the Site since contamination was identified in 1989. The locations of the IMs are shown on Figure 4-1.

- In response to the November 1989 PCE release, a SVE system consisting of vertical wells was installed. The SVE system operated until 1994 when it was replaced by a horizontal SVE system. The horizontal SVE system was decommissioned in the late 1990s. The total estimated cost for installation, operation, maintenance, and decommissioning of the systems was approximately \$360,000 for the vertical system and \$250,000 for the horizontal system.
- In 1994, a groundwater pump and treat system was installed to address source area contamination and provide hydraulic control and containment downgradient of the Unocal facility. Groundwater was extracted from 12 wells, treated through an air stripper and discharged to the City of Wichita Publicly Owned Treatment Works (POTW). The system was decommissioned in 2006, when the permit to discharge to the POTW expired. A total of 27,871,421 gallons of groundwater was recovered and treated during system operations. The total estimated cost for installation, operation, maintenance, and decommissioning of the system was approximately \$2,700,000.
- Several pilot tests and bench-scale studies were conducted in the mid-1990s to help identify potentially viable remedial alternatives for the Site, which included SVE, air sparging, and bench-scale bioremediation studies. The total estimated cost for these studies was approximately \$150,000.
- In September 1999, an enhanced bioremediation pilot treatability test was initiated to evaluate the efficacy of injecting a bioremediation product (e.g., hydrogen release compound (HRC®)) into the subsurface to encourage ERD in Plumelet A. Current data for the Site indicate that the injections continue to be effective, as contaminant

concentrations have remained at or near KDHE's residential Tier 2 Levels in the study area. The total estimated cost for the enhanced bioremediation pilot test is \$250,000.

- In October 2001, source area soil removal activities were initiated in three areas at the Site to address unsaturated vadose zone soil contamination. Excavation activities were terminated at the saturated zone. The areas excavated included an area extending from the Site entrance to the northwestern warehouse, an area north of the bioremediation pilot test, and a portion of the former AST farm. A total of 5,309 tons of contaminated soil were disposed as hazardous waste at the Lone Mountain Landfill in Waynoka, Oklahoma. The total estimated cost for the source area soil removal was approximately \$1,250,000.
- In December 2006, a second ERD pilot test was implemented on adjacent property to prevent contaminant migration and help reduce contaminant concentrations. The pilot test was implemented to meet the objectives of the groundwater pump and treat system which was decommissioned when the permit to discharge water to the City POTW expired. The pilot test was conducted on the adjacent Coleman property to the south. Two injectates were used to conduct a side-by-side comparison: HRC® was used in a downgradient transect and CAP18-ME™ was used in an upgradient transect. The test found that HRC® was successful at reducing concentrations of PCE and trichloroethene (TCE). Based on the results of the 1999 pilot test, it is expected that concentrations of cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC) will decrease over time. CAP18-ME™ was not determined to be as effective for quickly reducing contaminant concentrations. Wells associated with both transects will continue to be sampled for performance monitoring purposes. The total estimated cost for the second ERD pilot test was \$200,000.
- In June 2011, KDHE and Unocal entered into an Environmental Use Control (EUC) Agreement for the Site (FS Study Alternative 4). The purpose of the EUC is to protect human health and the environment from risks posed by contaminants remaining at the Site through placement of restrictions, prohibitions, and conditions on land use to reduce or eliminate potential human exposure to Site contaminants. The agreement runs with the property and is binding on the landowner and any other subsequent owners, lessees, and other users of the property. The total estimated cost for the EUC was \$10,000.

The total cost for these IMs and EUC is approximately \$5,170,000. In addition, Chevron EMC is proceeding with additional IMs and studies which are consistent with the technologies evaluated in the FS under Alternative 4. These IMs and studies are further discussed below. The total estimated costs are discussed in Section 7.1.4 of this document.

- In December 2009, an ERD IM was implemented in the Plumelet A source area, similar to the proposal described in Alternative 4 of the FS. A mixture of HRC [eXtended release formula] (HRC-X) and glycerol was injected throughout the saturated zone in four transects through the source area. Three northern transects were approximately 60 feet long. The southernmost transect, positioned to intersect any contamination that may

be leaving the Site from Plumelet A, was 100 feet long. Performance monitoring of the Plumelet A ERD IM is ongoing.

- Phytoremediation (FS Alternative 4) – In March 2010, KDHE approved a *Phytoremediation Interim Measure Work Plan*⁴ to facilitate implementation of the work plan during the optimal planting timeframe. The work plan was implemented in April 2010. The phytoremediation IM addresses contamination in Plumelets B and C in the western and central part of the Site, where the bedrock surface is relatively shallow. The phytoremediation system is designed to create a hydraulic barrier to mitigate contaminant migration and to remove dissolved-phase contaminants through various processes, including rhizodegradation and phytovolatilization. The phytoremediation tree stands have been designed to preclude the migration of contaminated groundwater outside of the area of influence during the dormant season. Consistent with Section 7.1.4. of this document, the FS identifies a contingent remedy should the IM be ineffective or inadequate to address contamination in Plumelets B and C. Performance monitoring of the IM is ongoing.
- Monitored Natural Attenuation (FS Alternative 4) – In June 2010, KDHE approved a work plan for evaluating the potential reduction of contaminants through monitored natural attenuation (MNA) in Plumelets D, E, and F as proposed in the FS. Data collected from the Site during the study, which was conducted from 2010 to 2011, indicate evidence that MNA and biodegradation has occurred in Plumelet D based on the overall reduction in contaminant concentrations over time; however, it appears biodegradation processes are not pronounced in Plumelets E and F; therefore, it has been determined by Chevron EMC and KDHE that MNA is not a viable remedial action alternative for Plumelets E and F. Consistent with Section 7.1.4. of this document, the FS identifies a contingent remedy of ERD should MNA be ineffective or inadequate to address contamination in Plumelets D, E and F; therefore, as of the date of this document, KDHE is working with Chevron EMC to determine the scope of work for contingency implementation in Plumelets E and F.

5. SITE RISKS

The implementation of IMs at the Site have significantly reduced the potential for exposure to contaminated soil at the Site; however, some isolated soil impacts remain at the Site. The EUC precludes residential use of the property, and requires notification to KDHE if soil excavation or installation of wells for monitoring purposes is needed. The restrictions of the EUC provide protections for workers at the Site if work that would impact the soil or groundwater is needed. Contaminant concentrations in groundwater exceed federal Maximum Contaminant Levels (MCLs) and could present an unacceptable risk posed by using groundwater for drinking or other household uses. The primary route of exposure to contaminants at the Site would be through contact with contaminated groundwater; however, no consumptive use of water wells are located

⁴ URS, 2010, *Phytoremediation Interim Measure Work Plan, Former Unocal Chemical Distribution Facility, Wichita, Kansas*, prepared on behalf of Chevron, approved April 2010.

within the area of impact. The City of Wichita Municipal Code of Ordinances, Title 7, Chapter 7.30, Section 7.30.105 currently prohibits the installation of new wells and use of pre-existing water wells for personal use in contaminated areas (such as the Former Unocal Site).

6. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are media-specific goals for protecting human health and the environment. RAOs are developed through evaluation of applicable and relevant and appropriate requirements (ARARs) and To Be Considered standards with consideration of the findings of the RI. Based on this information, the following RAOs were developed for the Site as presented below.

- Prevent human exposure (ingestion, inhalation, and dermal contact) to contaminated soil;
- Prevent human exposure (ingestion, inhalation, and dermal contact) to contaminated groundwater;
- Prevent contaminated groundwater from migrating downgradient at concentrations exceeding the KDHE residential Tier 2 Levels;
- Reduce the on-site contaminant concentrations in groundwater to the KDHE residential Tier 2 Levels as determined by KDHE; and,
- Reduce the downgradient contaminant concentrations in groundwater to the KDHE residential Tier 2 Levels as determined by KDHE.

6.1. Cleanup Levels

For groundwater remediation being conducted at sites with drinking water aquifers, federally promulgated MCLs are used as the cleanup levels. Even though groundwater in the vicinity of the Site is not currently used for drinking purposes, it is a potential source of drinking water in the future. Therefore, MCLs, where available, are the final remedial cleanup levels for the Site. For those constituents which federal MCLs have not been established for groundwater, KDHE's *Risk-Based Standards for Kansas (RSK)*⁵ Tier 2 Levels apply and are the final remedial cleanup levels for the Site. For soil, KDHE's RSK Tier 2 Levels are the final remedial cleanup levels for the Site.

KDHE has calculated RSK Tier 2 Levels for soil for the protection of human health and protection of groundwater. The RSK Tier 2 Levels and methods of calculation are identified in KDHE's *RSK Manual* (KDHE 2010). The RI identified isolated residual VOC soil impacts at the Site at concentrations above applicable Tier 2 Levels; however the soil contamination does not appear to be acting as a continuous source of contamination for the groundwater.

⁵ KDHE, 2010, *Risk-Based Standards for Kansas (RSK) Manual*, 5th Version, Kansas Department of Health and Environment, October.

The conclusions of the RI, the formulation of RAOs, and the determination of MCLs as the cleanup levels for groundwater and Tier 2 Levels as the cleanup levels for soil provide the basis for selecting a preferred remedial alternative. As previously discussed in Section 3.2, Tables 3-1 and 3-2 summarize the MCLs and Tier 2 Levels for contaminants in soil and groundwater.

7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED

In accordance with KDHE's RI/FS Scope of Work, several remedial action alternatives were assembled and evaluated in detail during the FS. Each remedial alternative was evaluated with respect to their ability to satisfy the following criteria as specified in the *National Oil and Hazardous Substances Contingency Plan*⁶ (NCP): overall protection of human health and the environment; compliance with federal and state ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness; implementability; and, cost. A detailed description of each remedial action alternative and the individual and comparative analyses is presented in the FS. Each remedial alternative evaluated also includes the numerous IMs already implemented at the Site that are consistent with the technologies evaluated in the FS.

The FS was performed in conjunction with the NIC Site FS. Evaluation of remedial alternatives in the FS focused on saturated soils and elevated dissolved-phase groundwater contamination at and near the former Unocal facility. Downgradient groundwater contamination in Plumelets A and B has been and is currently being addressed by a groundwater IM interceptor system, which is a component of the response actions performed to date. Any contamination beyond the downgradient extent of the IM system will be further addressed as part of the remedial strategy outlined in the Final CAD for Interim Groundwater Remediation for the NIC Site which is currently being designed to be implemented by the City of Wichita.

7.1. Remedial Alternatives Retained

Four remedial action alternatives were retained for detailed analysis for the Site. These include Alternative 1 – No Action; Alternative 2 – Monitored Natural Attenuation and Environmental Use Controls; Alternative 3 – Enhanced Reductive Dechlorination, Monitored Natural Attenuation, and Environmental Use Controls; and, Alternative 4 – Phytoremediation, Enhanced Reductive Dechlorination, Monitored Natural Attenuation, and Environmental Use Controls.

7.1.1. Alternative 1 – No Action

The NCP requires the evaluation of a No Action alternative to serve as a baseline for comparison to other remedial action alternatives evaluated. Typically, the No Action alternative means the Site is left unchanged, and no remedial actions are evaluated or taken at the Site; however, for the purpose of the FS and consistent with Environmental Protection Agency (EPA) guidance, the No Action alternative includes limited environmental monitoring, but no further actions would be taken to reduce contaminant mass, address potential exposure pathways, or reduce the potential for contaminant migration. Since no remedial action is taken, risks to human health

⁶ National Oil and Hazardous Substances Contingency Plan, 40 CFR 300 et seq.

and environment may not be addressed. Under this Alternative, groundwater monitoring would be conducted annually for a period of 30 years. The present value cost of Alternative 1 is \$1,326,440.

7.1.2. Alternative 2 – Monitored Natural Attenuation and Environmental Use Controls

This alternative includes limited environmental monitoring as discussed in Alternative 1; however, this alternative does not include any upfront active treatment or remediation beyond source control to reduce the toxicity, mobility, or volume of groundwater contamination. Instead, it relies on a combination of MNA processes and implementing EUCs at the Site. As summarized in Highlight 7-1, natural attenuation processes include those such as biodegradation, dispersion, dilution, absorption, and chemical reactions with subsurface materials to reduce contaminant concentrations in groundwater. Groundwater will be periodically monitored for VOC contaminant concentrations as well as natural attenuation indicator parameters for the purpose of evaluating: reducing anaerobic groundwater conditions; decreasing overall trends in contaminant trends; and observed degradation of primary contaminants of concern to daughter products (e.g., PCE to TCE, TCE to cis-1,2-DCE, cis-1,2-DCE to VC). MNA will be evaluated on a yearly basis in accord with EPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*⁷, and the implementation of this alternative will be subject to KDHE's BER Policy (BER-RS-42) entitled *Monitored Natural Attenuation of Volatile Organic Compounds in Groundwater*⁸.

This alternative also incorporates a contingent remedy of enhanced anaerobic bioremediation (EAB) via ERD should MNA be ineffective or inadequate to address contamination. Highlight 7-2 provides a summary of bioremediation processes. In addition, under this alternative, KDHE's EUC program would be utilized to limit potential exposure to Site contaminants. Periodic groundwater sampling and Site reviews would be conducted throughout the remedial action, assumed to be 30 years to document the effectiveness of the groundwater remedial

Highlight 7-1 – Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) relies on a suite of natural attenuation processes to reduce contaminant concentrations to acceptable levels. Without the right conditions, however, MNA will not be quick or effective enough to serve as an independent remedy.

Primary natural attenuation processes include biodegradation, dispersion, dilution, and absorption. KDHE and EPA have taken the position that the biological component must be active to support selection of MNA alone as the preferred remedy.

⁷ EPA, 1998, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (EPA/600/R-98/128), United States Environmental Protection Agency, Office of Research and Development, Washington, DC, September.

⁸ KDHE, 2012, *Monitored Natural Attenuation of Volatile Organic Compounds in Groundwater* (BER-RS-042), Kansas Department of Health and Environment, Bureau of Environmental Remediation, June.

strategy. The present value cost of Alternative 2, not including contingency implementation, is \$1,733,262.

7.1.3. Alternative 3 – Enhanced Reductive Dechlorination, Monitored Natural Attenuation, and Environmental Use Controls

This alternative combines the technologies presented in Alternative 2 with implementation of EAB via ERD in specific areas through injection of electron donor material (i.e., HRC®). Previous injection of HRC® at the Site decreased contaminant concentrations to below or near the KDHE residential Tier 2 Levels. Additional injections will be conducted as necessary to achieve RAOs. Injections will focus on source reduction, where petroleum hydrocarbon related constituents are not present, and on biobarriers along fence lines and plumelet boundaries to limit migration. Some areas of the Site will be subjected to MNA for a period of five years. If results from the routine monitoring events or the five year review indicate that MNA is ineffective, ERD will be implemented to prevent further migration and reduce areas with elevated concentrations of Site-related contaminants. Although ERD treatment injections are anticipated to take about 10 years, periodic Site reviews and additional groundwater monitoring will be ongoing for approximately 15 years to document the effectiveness of the groundwater remedial strategy. The present value cost of Alternative 3, not including contingency implementation, is \$1,409,848.

7.1.4. Alternative 4 – Phytoremediation, Enhanced Reductive Dechlorination, Monitored Natural Attenuation, and Environmental Use Controls

This alternative combines the technologies presented in Alternative 3 with the use of phytoremediation for hydraulic control and contaminant uptake in certain areas. A summary of phytoremediation technologies is provided in Highlight 7-3. Phytoremediation would be used by planting numerous rows of trees in boreholes on 10-foot centers in areas where the bedrock

Highlight 7-2 – Bioremediation

Bioremediation relies on natural biological processes to breakdown harmful chemicals in the subsurface. Throughout this CAD bioremediation is referred to as enhanced reductive dechlorination (ERD) and enhanced anaerobic bioremediation (EAB).

In order for bioremediation to be successful, the right microbes, nutrients, temperature and amount of oxygen must be present. Different microbes are needed depending on the contaminants present at a site. It is often necessary to add amendments, microbes, or other organic source material to the aquifer to allow microbes to thrive and to speed up bioremediation processes.

To determine what enhancements are necessary, pilot testing is often conducted. Because remediation is conducted in the subsurface, bioremediation-based remedies largely reduce the amount of wastes generated from a contaminated site.

surface is relatively shallow (less than 25 feet below grade). Phytoremediation will be used downgradient of the source area for hydraulic control. Additionally, HRC® injections alone will be used to treat the Plumelet A source area and prevent further migration from this area since the depth to bedrock in this area is greater than the effective depth of a phytoremediation system. Additional injections will be conducted as necessary to achieve RAOs.

Consistent with the other alternatives, some parts of the Site will again be subjected to MNA. If results from routine monitoring events or a five year review indicate that MNA is ineffective, or phytoremediation is shown to be an ineffective remedy at the Site, EAB via ERD will be implemented to prevent further migration and reduce areas with elevated concentrations of Site-related contaminants. Although ERD treatment injections are anticipated to take about 10 years, periodic Site reviews and additional groundwater monitoring will be ongoing for approximately 15 years to document the effectiveness of the groundwater remedial strategy. The present value cost of Alternative 4 evaluated in the FS, not including contingency implementation, is \$1,440,296; however, as discussed in Section 4, as of the date of this document, Chevron EMC is proceeding with additional IMs and studies which are consistent with the technologies evaluated in the FS under Alternative 4. As ERD contingency for Plumelets E and F will be part of the remedy, and additional injections will be administered down gradient of the Site, estimated costs for these scopes of work are estimated at approximately \$273,000. On this basis, revised total present value cost of Alternative 4 is \$1,713,296.

Highlight 7-3 – Phytoremediation

Phytoremediation is the direct use of living green plants and their associated microorganisms to stabilize or reduce contamination in soils, sludges, sediments, surface water, or groundwater. Because it is a natural process, phytoremediation can be an effective remediation method at a variety of sites and on numerous contaminants.

The use of stands of deep-rooted trees, such as willow and poplar trees, have been shown to provide hydraulic control and influence groundwater flow patterns, reduce contaminant mobility, and enhance biodegradation of chlorinated solvents in the root system. The phytoremediation process also allows for contaminant uptake through the trees, which is distributed to the leaves, and then photovolatilized in the atmosphere.

Phytoremediation technologies are becoming attractive alternatives to conventional cleanup technologies because these systems have relatively low capital costs compared to other remedial methods, are energy efficient, and aesthetically appealing as they preserve the natural state of the environment.

8. DESCRIPTION OF THE PREFERRED REMEDY

After evaluation of the individual analysis of remedial action alternatives, a comparative analysis of the various alternatives was performed with consideration of the threshold and balancing criteria specified in the NCP as discussed in Section 7.0. On the basis of information available in the Administrative Record and summarized above, KDHE has selected Alternative 4, Phytoremediation, ERD, MNA, and EUCs, as the preferred remedy for the Site. The results of the comparative analysis support the preferred remedy for the Site as outlined below. The total present value cost of the preferred remedy is \$1,713,296 as presented in Table 8-1. A summary of the technologies proposed in Alternative 4 for various plumelets is shown on Figure 8-1.

Alternative 4 incorporates the IMs implemented at the Site to date, including, phytoremediation, ERD, groundwater pump and treat, soil excavation and off-site disposal, and SVE. These IMs are more thoroughly described in associated documentation and Section 4 above. The preferred remedy as outlined below satisfies or meets Federal, State, and local requirements, and will be protective of human health and the environment.

8.1. Elements of the Preferred Remedy

Elements of KDHE's preferred remedy (Alternative 4) are summarized below.

- *Phytoremediation* – As previously discussed in Section 4, in April 2010, Chevron EMC implemented the KDHE approved *Phytoremediation Interim Measure Work Plan* (URS 2010) to facilitate implementation of the work plan during the optimal planting timeframe. The phytoremediation IM addresses contamination in Plumelets B and C in the western and central part of the Site, where the bedrock surface is relatively shallow. The phytoremediation system is designed to create a hydraulic barrier to mitigate contaminant migration and to remove dissolved-phase contaminants through various processes, including rhizodegradation and phytovolatilization. The phytoremediation tree stands have been designed to preclude the migration of contaminated groundwater outside of the area of influence during the dormant season. Consistent with Section 7.1.4 of this document, the FS identifies a contingent remedy of ERD should phytoremediation be ineffective or inadequate to address contamination in Plumelets B and C. Performance monitoring of the IM is ongoing.
- *Monitored Natural Attenuation* – As previously discussed in Section 4, data collected from the Site during the recent MNA study conducted in 2010-2011 indicate evidence that MNA and biodegradation has occurred in Plumelet D based on the overall reduction in contaminant concentrations over time; however, it appears biodegradation processes are not pronounced in Plumelets E and F; therefore, it has been determined by Chevron EMC and KDHE that MNA is not a viable remedial action alternative for Plumelets E and F. Consistent with Section 7.1.4 of this document, the FS identifies a contingent remedy of ERD should MNA be ineffective or inadequate to address contamination in Plumelets D, E and F; therefore, as of the date of this document, KDHE is working with Chevron EMC to determine the scope of work for contingency implementation of ERD in

Plumelets E and F. Future actions anticipated for Plumelet D, within the scope of MNA, are as follows: groundwater samples from areas subject to MNA will be collected and analyzed for VOCs in addition to the parameters described in EPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (EPA 1998), and KDHE's BER Policy (BER-RS-42) entitled *Monitored Natural Attenuation of Volatile Organic Compounds in Groundwater* (KDHE 2012). The sampling frequency for the areas subjected to MNA is to be determined and will be specified in the operation, maintenance and monitoring (OM&M) plan discussed below. Should contaminant trends indicate plume expansion in Plumelet D, or if MNA does not otherwise appear to be effective, the contingent remedy (e.g., ERD), also described below, will be implemented.

- *Operation and Maintenance and Monitoring Activities* – A Site-wide OM&M plan will be developed following issuance of the Final CAD. OM&M activities will be conducted to assess and maintain the effectiveness of the remedial systems at the Site. Such activities will include injection and periodic reinjection of electron donor materials in the on-site Plumelet A source area, Plumelets E and F, and downgradient transects (located on the Coleman property), as well as tasks needed to ensure proper operation of the phytoremediation system (e.g., herbicide application to prevent undesired plant growth, tree replacement, among others). As of the date of this document, Chevron EMC has implemented a KDHE approved OM&M plan for the phytoremediation system. This phytoremediation OM&M plan, including any necessary modifications to the existing OM&M plan, will be incorporated into the Site-wide OM&M plan.

A Site-wide monitoring program will be implemented at the Site to confirm that impacts are not expanding or increasing in concentration and to document the effectiveness of the remedial actions in reducing the volume and mass of contaminants in groundwater. Future iterations of the groundwater monitoring program may include installation of additional monitoring wells to better assess plume orientation and dynamics. The inclusion of phytoremediation as a component of the preferred remedy necessitates a number of specialized monitoring activities including hydraulic monitoring, sap flow rates, and other measurements and observations to assess the health and viability of the tree stands for remediation purposes. Additional remedial actions will be considered for the Site if monitoring data suggest that the implemented remedial actions are ineffective in remediating the source areas and preventing the downgradient migration of groundwater contamination and further degradation of the aquifer.

- *Environmental Use Controls* – As previously discussed in Section 4, in June 2011, KDHE and Unocal entered into an EUC Agreement for the Site. The purpose of the EUC is to protect human health and the environment from risks posed by contaminants remaining at the Site through placement of restrictions, prohibitions, and conditions on land use to reduce or eliminate potential human exposure to Site contaminants. In addition, under the terms of the EUC, special restrictions for the Site include the requirement of a vapor intrusion investigation prior to the design or construction of any new buildings, extensions, or construction elements as to protect against potential vapor

intrusion risks. The EUC agreement runs with the property and is binding on the landowner and any other subsequent owners, lessees, and other users of the property. In addition, the City of Wichita Municipal Code of Ordinances, Title 7, Chapter 7.30, Section 7.30.105 currently prohibits the installation of new and use of pre-existing water wells for personal use in contaminated areas (such as the Former Unocal Site). Continued enforcement of this City ordinance will also help ensure protection of human health until Site cleanup is complete.

- *Contingent Remedy* – Previous pilot testing conducted at the Site has confirmed that ERD is effective at reducing groundwater contaminant concentrations. As such, the contingent remedy includes the installation of additional injection transects in areas where primary remedial actions are ineffective. This may include supplemental injection transects in areas targeted for phytoremediation if contaminant migration is evident before the tree stands reach maturity. As previously discussed in Section 4, and consistent with Section 7.1.4 of this document, the FS identifies a contingent remedy of ERD should MNA be ineffective or inadequate to address contamination at the Site.

9. COMMUNITY INVOLVEMENT

A Public Information Strategy for the Site was developed by KDHE. Public input and comment has been encouraged by KDHE throughout the process. Public notice of the availability of the draft CAD will be published in *The Wichita Eagle*. In addition, KDHE has established a webpage dedicated to the Site, available online at http://www.kdheks.gov/remedial/site_restoration/unocal.html. Many Site documents, including the draft CAD, are available on the webpage.

KDHE will select a final remedy after reviewing and considering all information submitted during the 30-day public comment period (February 11, 2013 – March 12, 2013). KDHE may modify the preferred remedy based on new information or public comments. The public is encouraged to review and comment on the preferred remedy presented in this draft CAD. As per the Public Information Strategy, KDHE will hold a public availability session during the public comment period to present information regarding the preferred remedy and solicit public participation. Notice of the public availability session will be published in *The Wichita Eagle* and posted on KDHE's webpage dedicated to the Site.

The public may provide comments on the draft CAD during the 30-day public comment period. Public comments on the draft CAD may be submitted to KDHE in writing during the 30-day public comment period. Written comments must be postmarked by March 12, 2013, and mailed to the name and address specified below:

Kansas Department of Health and Environment
Bureau of Environmental Remediation
1000 SW Jackson Street; Suite 410
Topeka, Kansas 66612-1367
Contact: Holly Burke, Environmental Scientist
Phone: 785-296-6242

Draft Corrective Action Decision
Former Unocal Chemical Distribution Facility Site - Wichita, Kansas
February 11, 2013



Comments on the draft CAD may also be submitted to KDHE by electronic mail to hburke@kdheks.gov. Comments sent by electronic mail must be received by KDHE by 5:00 p.m. on March 12, 2013. All comments that are received by KDHE prior to the end of the public comment period will be addressed by KDHE in the Responsiveness Summary Section of the Final CAD.



TABLES

Table 3-1 – Site-Related Historical and Current Maximum Groundwater Contaminant Concentrations

Chemical Compound	Maximum Concentration µg/L	Current Maximum Concentration µg/L (2011)	MCL or KDHE Tier 2 Level [‡] µg/L
PCE	110,000	3,500	5
TCE	90,000	1,800	5
cis-1,2-DCE	33,000	33,000	70
Vinyl chloride	9,000	3,200	2
1,1,1-Trichloroethane	28,000	150	200
1,1-Dichloroethene	3,000	2,700	7
1,2,4-Trimethylbenzene	1,000	190	8.44
1,3,5-Trimethylbenzene	960	53	44
Naphthalene	18,000	140	1.11
Benzene	3,820	760	5
Toluene	65,000	8,100	1,000

[‡]KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for groundwater provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.

µg/L – micrograms per Liter

Table 3-2 – Site-Related Maximum Soil Contaminant Concentrations

Chemical Compound	Maximum Concentration µg/kg	KDHE Tier 2 Level [†] (Soil to Groundwater Residential Pathway) µg/kg	KDHE Tier 2 Level ^{††} (Soil Pathway) µg/kg
PCE	21,340	121	109,000
TCE	1,860	84.2	5,850
cis-1,2-DCE	150,000	855	115,000
Vinyl chloride	1,451	20.5	4,470
1,1,1-Trichloroethane	260,000	2,800	11,800,000
1,1-Dichloroethene	1,200	85.9	313,000
1,2,4-Trimethylbenzene	40,000	1,070	54,000
1,3,5-Trimethylbenzene	13,000	5,510	243,000
Naphthalene	9,000	349	30,500
Benzene	2,000	168	15,900
Toluene	610,000	51,200	4,320,000

[†]KDHE Tier 2 Levels default to MCLs where available. Tier 2 Levels for soil and soil to groundwater pathway provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.

^{††}KDHE Tier 2 Level for the PCE soil pathway increased from 7,540 µg/kg to 109,000 µg/kg as of March 7, 2012, as calculated based on the revised toxicity data in the EPA's Integrated Risk Information System (IRIS), revised February 10, 2012. KDHE Tier 2 Level for the TCE soil pathway decreased from 41,000 µg/kg to 5,850 µg/kg as of November 17, 2011 as calculated based on the revised toxicity data in the EPA's IRIS, revised September 28, 2011.

µg/kg – micrograms per Kilogram



Table 8-1 – Summary and Estimated Cost of the Preferred Alternative for the Site

Preferred Alternative	Contingency	Estimated Cleanup Timeframe	Total Capital Cost	Total O&M Cost	Total Estimated Capital Costs for Plumelets E and F Contingency, and Down Gradient Rejections§	Present Value Cost
Alternative 4: Phytoremediation, Enhanced Bioremediation via ERD, MNA, and EUC, includes Environmental Monitoring	Enhanced Bioremediation via ERD	15 Years	\$545,470	\$894,826	\$273,000	\$1,713,296
Total Estimated Present Value Cost#						\$1,713,296

[#]Costs estimated by URS. Costs presented in the column "Total Capital Cost" do not include contingency implementation.
[§]Estimated Costs not provided in the Feasibility Study for the Site; these costs were estimated by URS and provided to KDHE on November 6, 2012.

FIGURES

Figure 2-1 – Facility Location within the North Industrial Corridor Site

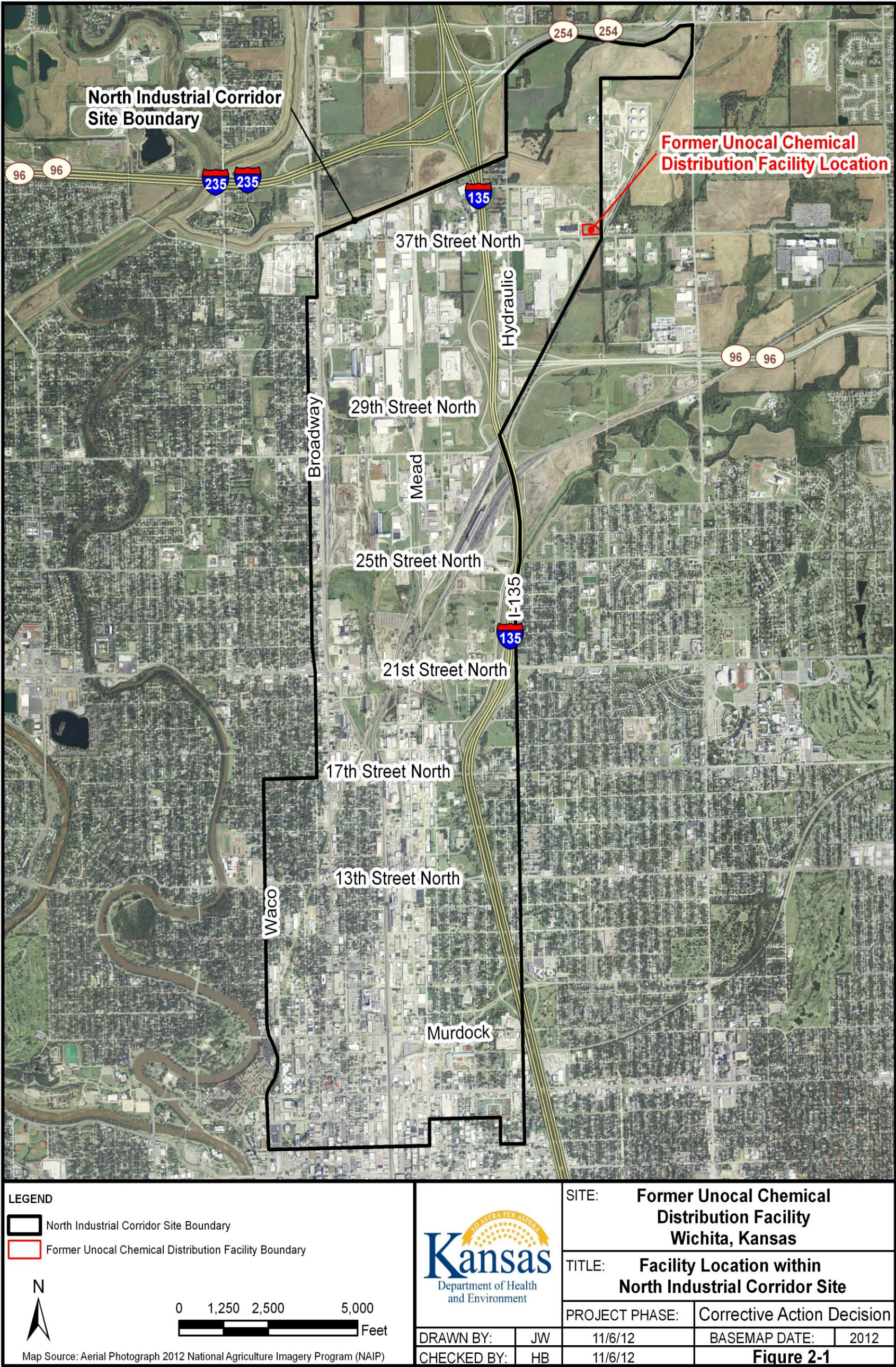


Figure 2-2 – Former Facility Layout and Primary Source Areas

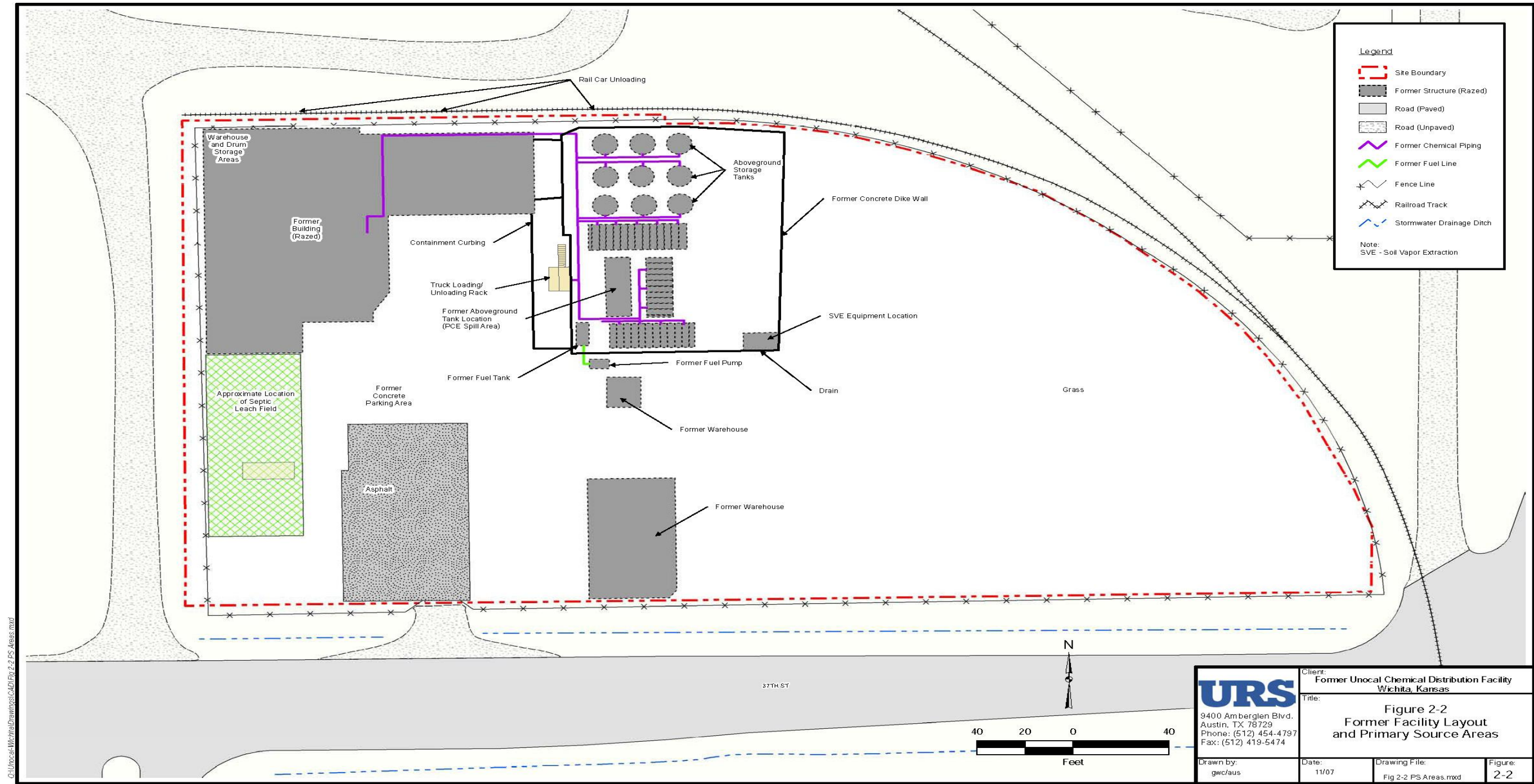


Figure prepared by URS on behalf of Chevron-EMC based on Figure 2-2 from the Final Remedial Investigation Report, November 2007.

Figure 3-1 – Top of Weathered Bedrock and Groundwater Flow Directions

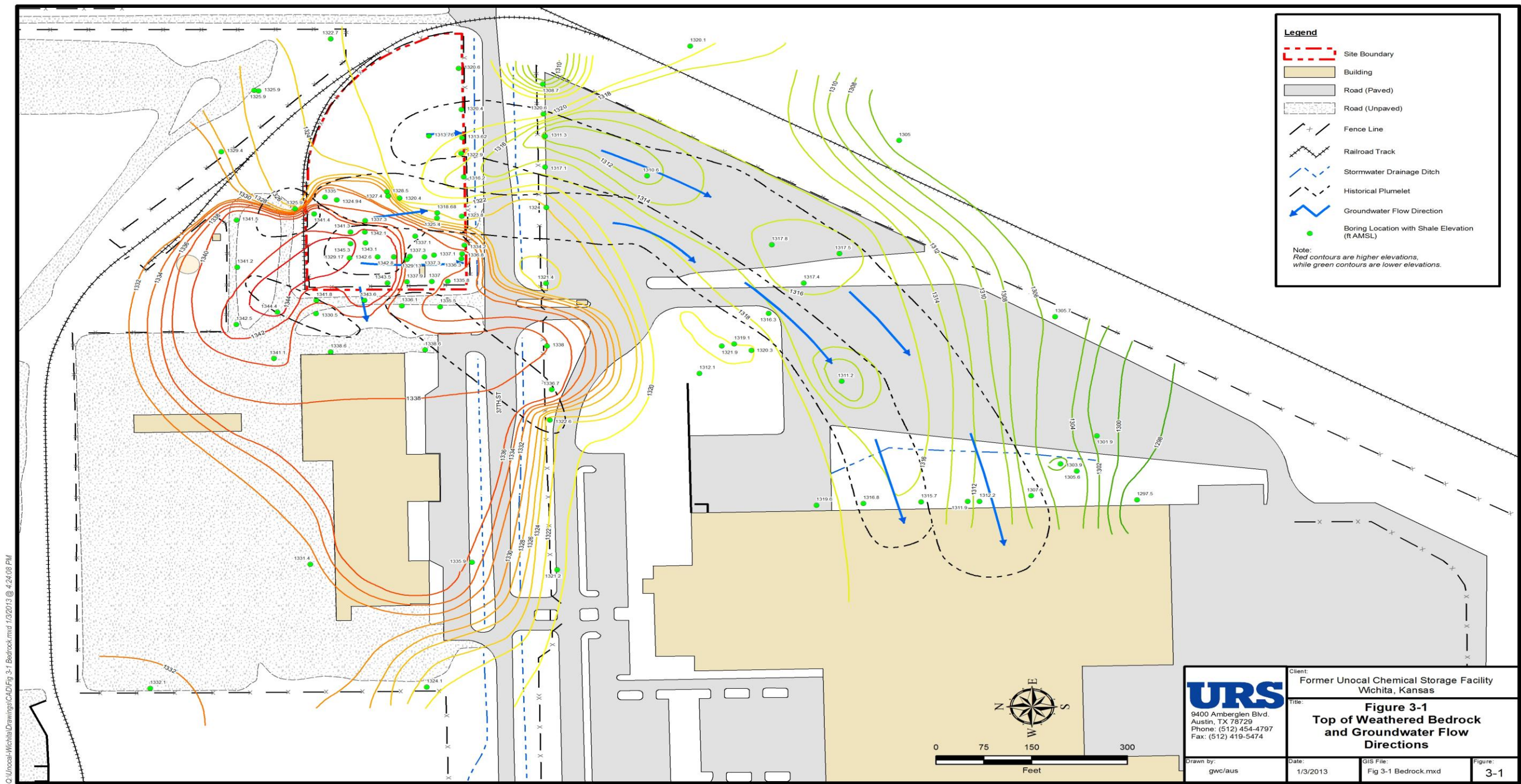


Figure prepared by URS on behalf of Chevron-EMC based on Figure 2-3 from the Feasibility Study Report, June 2009.

Figure 3-2 – Potentiometric Surface (June 2011)

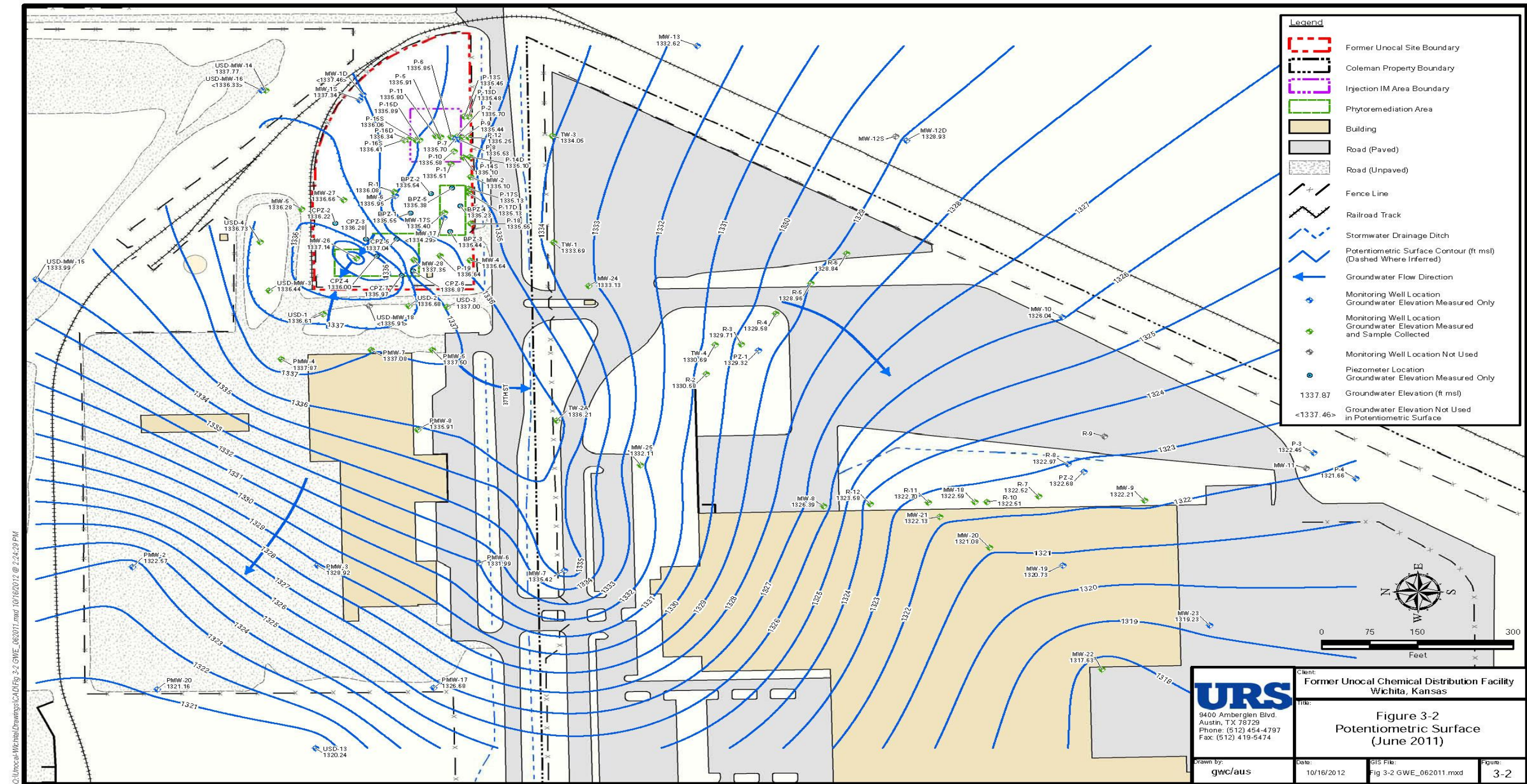


Figure prepared by URS on behalf of Chevron-EMC based on Figure 2 from the 2011 Annual Groundwater Monitoring Report, December 2011.

Figure 3-3 – Site-Wide PCE Concentrations in Groundwater (June 2011)

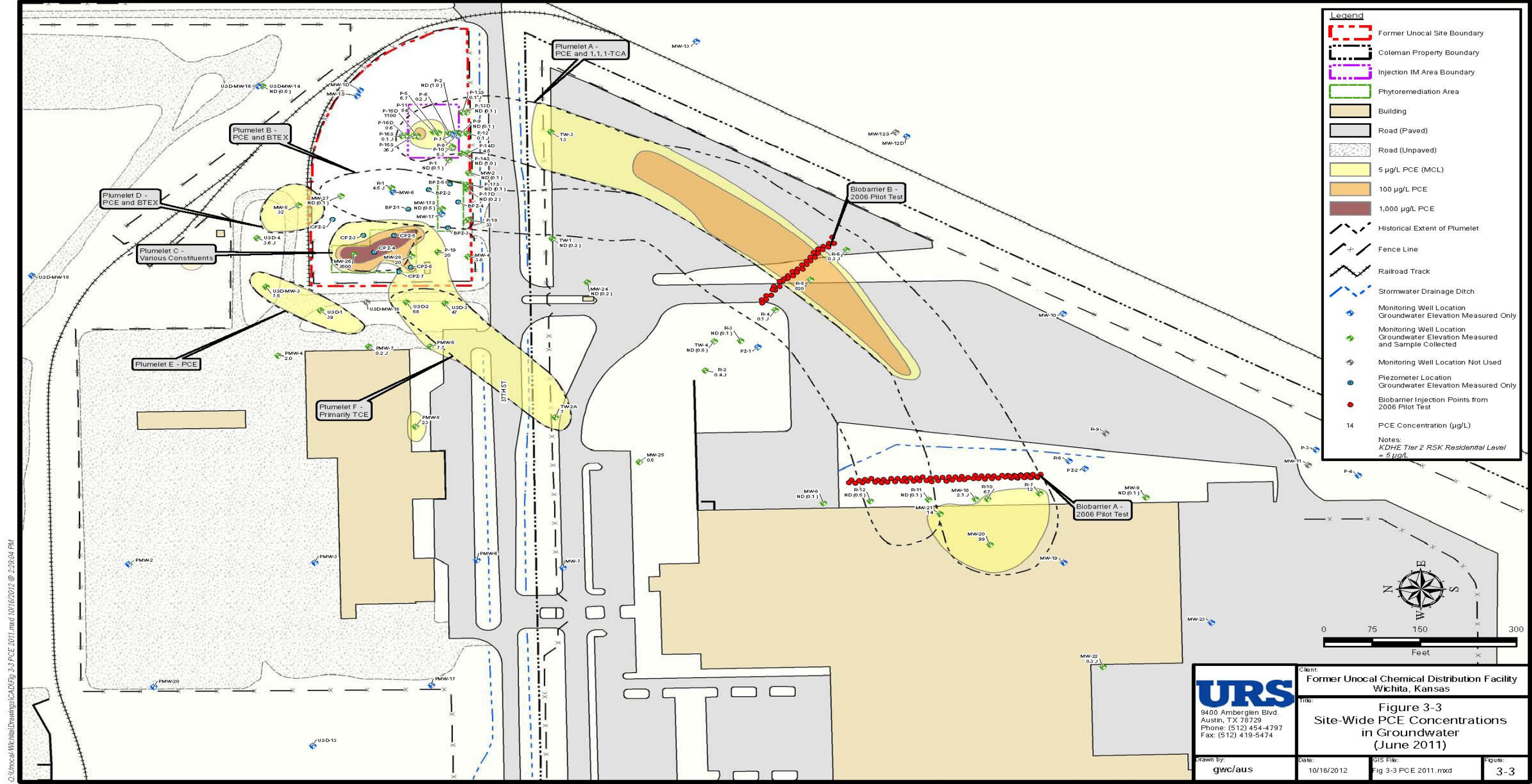


Figure prepared by URS on behalf of Chevron-EMC based on Figure 4 from the 2011 Annual Groundwater Monitoring Report, December 2011.

Figure 4-1 – Location of Interim Measures Implemented at the Site

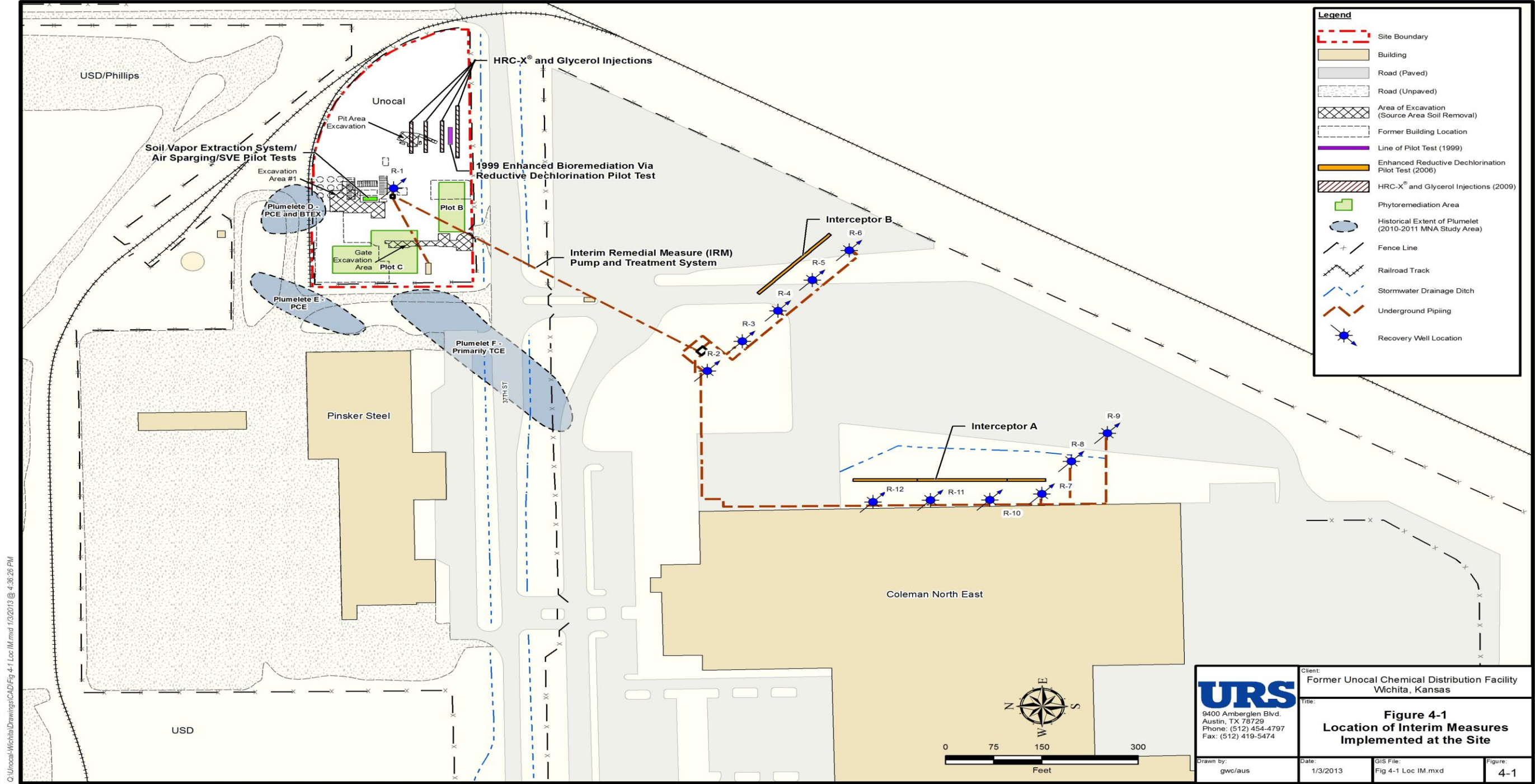


Figure prepared by URS on behalf of Chevron-EMC based on updated Figure 2-2 from the Feasibility Study Report, June 2009.

Abbreviations
 PZ or P = Piezometer
 MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
 USD = Monitoring Well on USD Property
 PMW = Monitoring Well on Pinsker Property
 R = Recovery Well (Not Pumping During 2005 Event)
 TW = Test Well
 USD-MW = Monitoring Well on USD Property Installed by Unocal

Note:
 PCE concentrations are from the 2008 Annual Groundwater Monitoring Event (July-August 2008).
 The use and location of injection barriers in Plumelet B are based on the location of former source area and MIP-27 results. Injection barriers and phytoremediation area will be evaluated based on the sample results from MW-27 and MW-17S.

Legend
 - - - - - Former Unocal Site Boundary
 - - - - - Road (Paved)
 - - - - - Road (Unpaved)
 - - - - - Phytoremediation Area
 - - - - - Fence Line
 - - - - - HRC-X® and Glycerol Injections (2009)
 - - - - - Railroad Track
 - - - - - Stormwater Drainage Ditch
 - - - - - Historical Plumelet
 - - - - - Groundwater Flow Direction
 - - - - - Groundwater Elevation Measured for Long-Term Monitoring
 - - - - - Groundwater Elevation Measured and Sample Taken for Long-Term Monitoring
 - - - - - Groundwater Elevation Measured and Sample Taken for MNA Monitoring
 - - - - - Proposed Monitoring Well Location
 - - - - - Groundwater Elevation Measured and Sample Taken for MNA Monitoring

Figure 8-1 Complete Alternative 4

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Client:
 Former Unocal Chemical Distribution Facility
 Wichita, Kansas

Date:
 1/3/2013

GIS File:
 Fig 8-1 Comp Alt 4.mxd

Figure:
 8-1

-32-